



Diversity of Soil Nematodes in Agricultural Fields with Different Crops

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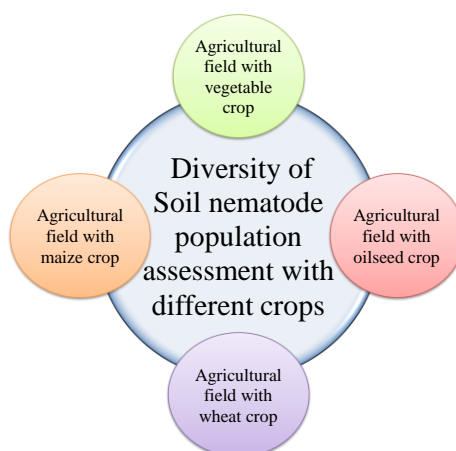
Article History	Abstract
Received: 04 June 2023 Revised: 09 Sept 2023 Accepted: 07 Oct 2023	<p>Agriculture has been significant part of the Indian livelihood since ages. As agriculture rely upon the various aspects such as quality of soil, soil minerals and nematodes present in soil. In the present project of soil nematode diversity is successfully estimated by using nematode extraction method given by Cobb (1918). The experiments were performed on soil sample which were collected from four different sites during the study. These four sites were agricultural fields located in Sri Anandpur Sahib (India) with different crops viz; Site 1: Agricultural field with vegetable crops, Site 2: Agricultural field with oilseed crops, Site 3: Agricultural field with wheat crops, Site 4: Agricultural field with Maize crop. The estimation part of the study was performed at PG Zoology Laboratory of PG Department of Zoology, Sri Guru Teg Bahadur Khalsa College, Sri Anandpur Sahib, Punjab, India. The six nematode species were recorded with 100% frequency along with sixteen species of nematodes with 90% frequency of occurrence in all agricultural sites selected during present study. Additionally, eighteen nematode species were recorded with 80% frequency of occurrence in all sites. Apart from this, the nematode species <i>H. indicus</i> and <i>T. hynchus</i> spp. were recorded with 70% frequency of occurrence. It can be deduced from the present experimental program that the beneficial nematodes were present abundantly in all the soil samples of selected sites. Thus, it can be stated that, to improve the soil fertility the eco-friendly agricultural practices would be an efficient approach as it foster the soil nematode diversity.</p>
CC License CC-BY-NC-SA 4.0	Keywords: Soil Nematodes, Eco friendly Agricultural Practices, Frequency of occurrence

1. Introduction

Thousands of species of nematodes are introduced in soil biota. It is wonderful home ground for nematodes and due to their importance in agriculture, far more is thought concerning plant-parasitic nematodes. They are helpful in decomposition of organic matter and live at intervals of plant roots; most nematodes inhabit the skinny film of wetness around soil particles [1]. Many feeding groups of nematodes unremarkably occur in most soil e.g., Aligovores which feed on algae, Herbivores which feed on plants [2]. Their feeding recycles minerals and alternative nutrients from a bacterium, fungi, and alternative substrates and returns them to the soil, wherever they are accessible to plant roots. These microorganisms are present in fresh or marine water but the soil is the primary habitat of nematodes. Bacterivores which feed on bacteria or microorganism as well as Fungivores which feed on fungi, maintains the nitrogen cycle in the organic soil [3,4]. The nitrogen-based proteins in the form of nitrogen-containing compound consumed by bacterial feeder nematodes and produce a large amount of nitrogen in the form of ammonium. The nitrogen produced is used by plants and nematodes which improve recycling, feeding activity of nematodes, increase the rate of decomposition and increase the fertility of the soil. Predators, which feed on each plant-parasite or non-symbiotic nematodes and protozoan as well as omnivorous nematodes feeding on food sources but in the absence of a food source, they feed on bacteria and fungi [4,5,6]. Nematodes present in different fields can be assessed, to establish the count of nematodes in different soil fields. The present study was envisaged with the

objective to analyze biodiversity of nematodes to exploit the importance of economic important soil nematode biota.

Objectives



2. Materials and Methods

The species found on sites identified by Morphological and biochemical identification. These species of nematodes are plant parasitic and root knot nematode of great economic importance. Species were identified with the help of light microscopic technique by their morphological patterns. In nematodes the perineal pattern is identified by posterior region of adult female, the vulva- anus area, phasmid, lateral lines, tail terminus, and cuticular striate. The identification of various species of nematodes with different crop fields is identified by their morphological characters [10].

In the present study, Cobb's technique with slight modification was used to extract the nematodes from soil was used [11]. To processing this technique various types of instruments and materials used were as under: Borosilicate glass beaker, stirring rods, plastic bowls and set of Cobb's sieves, distilled water, decanting tray with cross piece, extraction sieves with supporting wires and clamping ring which protect the nematode filter, watch glass, extraction dish, any type of covering material which cover the extraction dish and also required 20°C temperature [11,12].

This method was based on differences in size, shape and sedimentation rate of nematodes, soil particles and worm mobility. The soil sample stirred in beaker with water which separates the nematodes from soil particles. When the heavy particles settled down at the surface, the nematode sample was poured off and sieved. The nematodes stayed in the sieve and the soil particles or other small particles were passed through. Sieving was administered with a sequence of sieves of decreasing mesh size, so the particular nematodes of various sizes can be collected easily.

Field sites

The agricultural fields of Sri Anandpur Sahib, District Ropar, Punjab, India was chosen to collect the sample and analyses the soil nematode biota. The details of the sites chosen are as under:

Table 1: Details of the sites chosen for the present study

S. No.	Site Number	Site Name
1	Site 1	Agricultural Filed with Vegetable crop
2	Site 2	Agricultural Filed with Oilseed crop
3	Site 3	Agricultural Filed with Wheat crop
4	Site 4	Agricultural Filed with Maize crop

During this experimental work, Cobb's Sieving and Decanting technique was used with slight modifications for extraction of nematodes from the soil samples collected with following steps:

1. From each agricultural site 10 soil samples each were collected.
2. The soil samples were collected with the help of trowel at 10-15cm depth covering 20-30cm radius.
3. Nematode population per 200cc of soil was estimated.
4. The data was collected, maintained and analyzed in the Zoology Laboratory of PG Department of Zoology, Sri Teg Bahadur Khalsa College, Sri Anandpur Sahib.
5. The data of collection was subjected to mathematical formulations to calculate different parameter of population densities as per Norton, 1978.

$$\text{Frequency of occurrence (\%)} = \frac{\text{Number of samples in which a particular species occurred}}{\text{Total number of samples collected}} \times 100$$

$$\text{Relative Frequency (\%)} = \frac{\text{Frequency of occurrence}}{\text{Sum of frequency of all nematode species}} \times 100$$

3. Results and Discussion

All the sites chosen for the present study were visited five times during the study period and ten samples per site were collected and stored in plastic zip bags. Samples were brought to the lab and subjected to sieving and decanting technique steps. The results obtained were discussed as under:

Site 1: Agricultural field with vegetable crop

At site 1, all the species were reported from maximum 10 and minimum from 7 samples out of 10. Out of all the four sites, site 1 was found to be field with maximum number of nematode species. In this field, 17 species of nematode were recorded (Figure 1.1). *Rotylenchus buxophilus* and *R. reniformis* were recorded in all the samples collected with 100% Frequency of occurrence and 6.75% Relative frequency. Nine species the *Longidorus elongates*, *Meloidogyne incognita*, *Merlinius brevidens*, *Paratylenchus* spp., *P. penetrans*, *P. terese*, *Trichodorus* spp., *Tylenchus* spp. and *Xiphinema* spp. were recorded in all the samples collected with 90% Frequency of occurrence and 6.08% Relative frequency. Five species viz; *Meloidogyne* spp., *H. teres*, *Helicotylenchus* spp., *Hoplolairnus indicus* and *Scurellonem apetersi* were recorded in all the samples collected with 80% Frequency of occurrence and 5.40% Relative frequency. *Helicotylenchus indicus* was recorded in all samples collected with 70% Frequency of Occurrence and 4.72% Relative frequency (Figure 1.2).

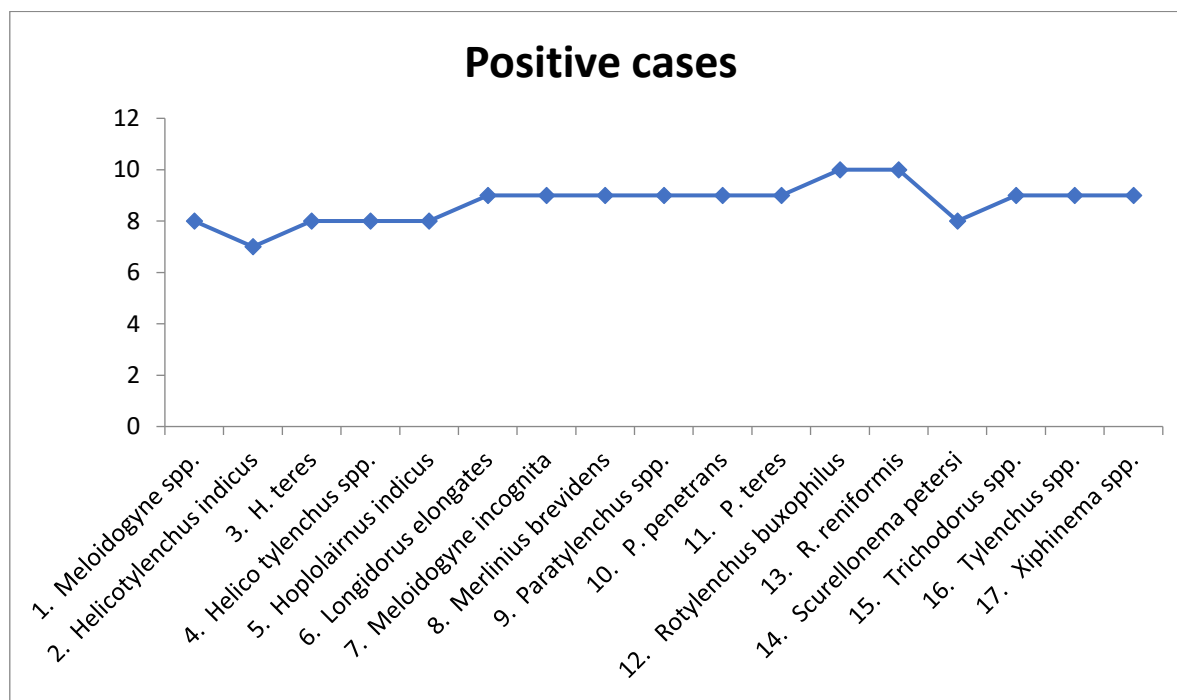


Figure 1.1 Positive cases at site 1 Agriculture field with vegetable crops

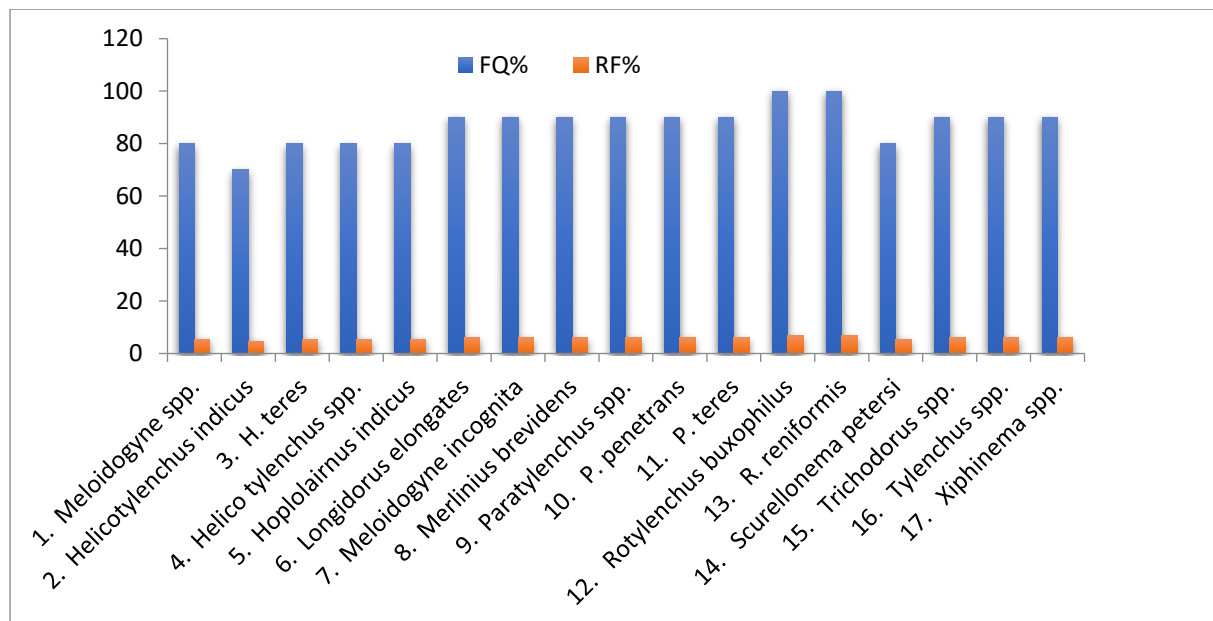


Figure 1.2 Frequency of occurrence and Relative frequency of nematode species at site 1 Agriculture field with vegetable crops.

Site 2: Agriculture field with oilseed crop

At site 2, all the species were reported from maximum 10 and minimum from 7 samples out of 10 (Figure 2.1) Out of all the four sites, site 2 was found to be field with minimum number of nematode species. In this field, 5 species of nematode were recorded. Three species viz; *M. incognita*, *Pratylenchus coffeae*, and *P. teres* were recorded in all the samples collected with 100% Frequency of occurrence and 20.83% Relative frequency. *Meloidogynea renaria* and *Merlinius breuidens* were recorded in all the samples collected with 90% Frequency of occurrence and 18.75% relative frequency. (Figure 2.2)

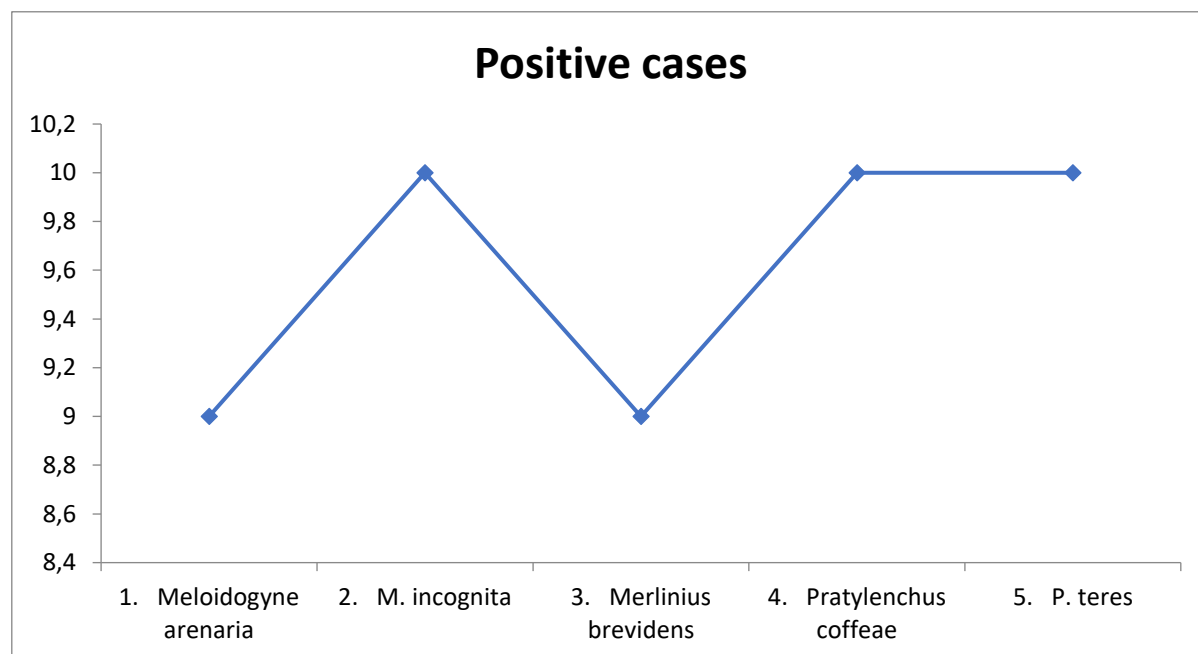


Figure2.1. Positive cases at site 2 Agriculture field with oil seed crops

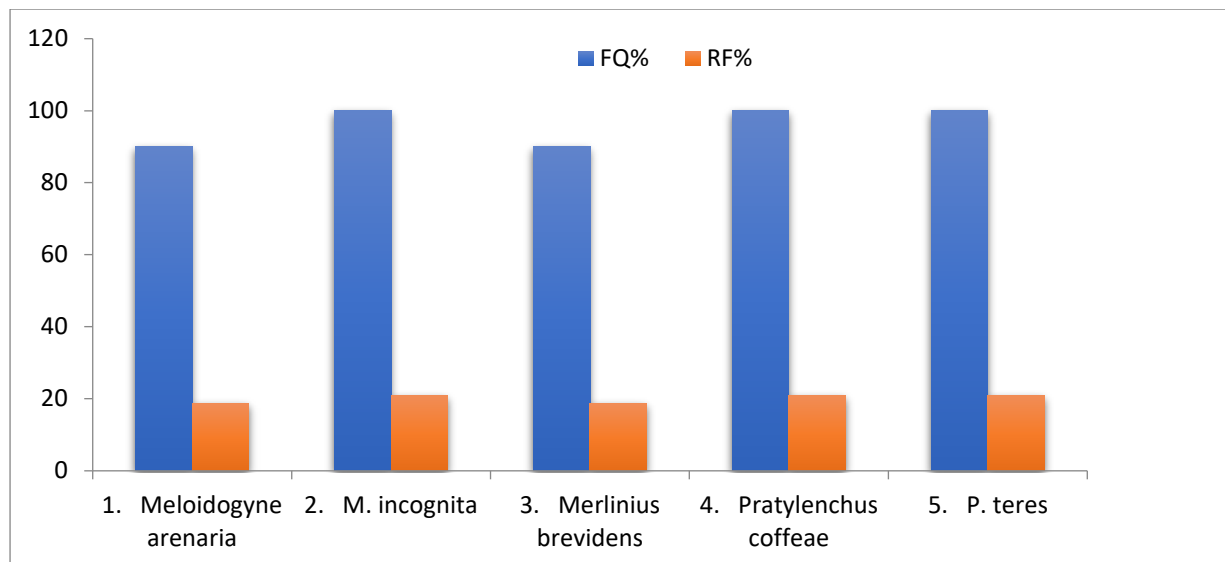


Figure 2.2. Frequency of occurrence and Relative frequency of nematode species at site 2 Agriculture field with oil seed crops.

Site 3: Agriculture field with wheat crop

At site 3, all the species were reported from maximum 10 and minimum from 7 samples out of 10 (Figure 3.1). Out of all the four sites, site 3 was found to be field with medium number of nematode species. In this field, 13 species of nematode were recorded. All the 13 species *Anguina tritici*, *Aphelenchus avenae*, *Criconema spp.*, *Helicotylenchus spp.*, *Herodera avenae*, *Hoplolaimus indicus*, *Herodera avenae*, *Hoploairmus indicus*, *Pratylenchus coffeae*, *P. neglectus*, *P. thornei*, *Prarylenchus spp.* And *Tylenchor hynchus* were recorded in all the samples collected with 80% Frequency of occurrence and 7.69% Relative frequency (Figure 3.2).

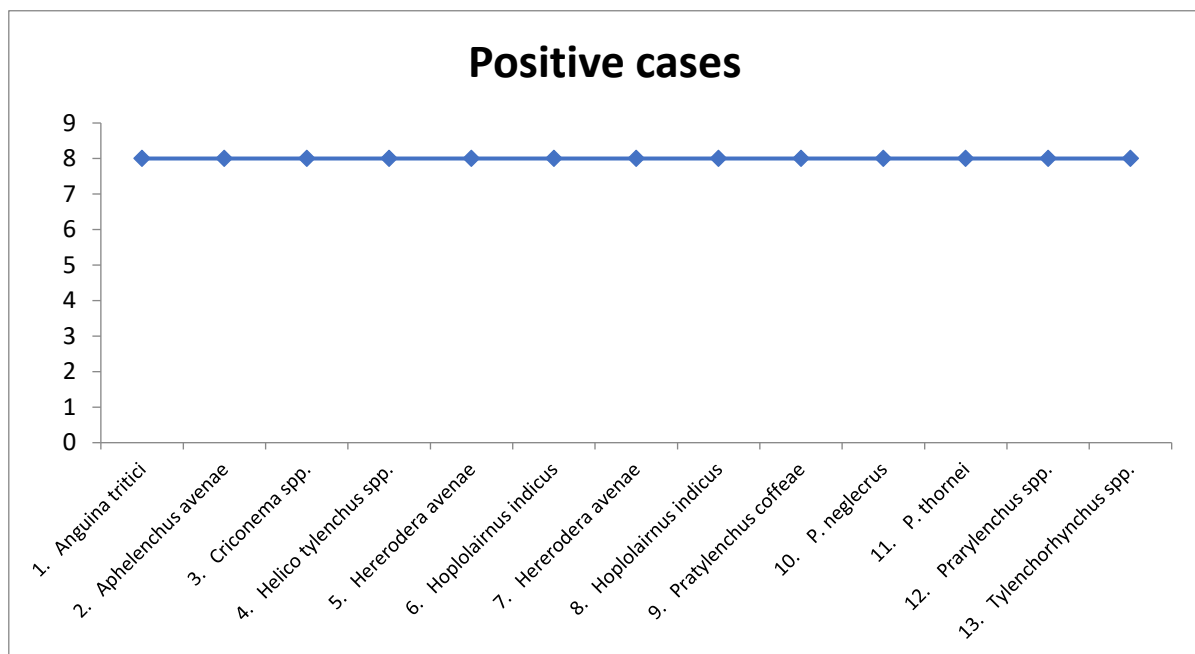


Figure3.1. Positive cases at site 3 Agriculture field with wheat crop

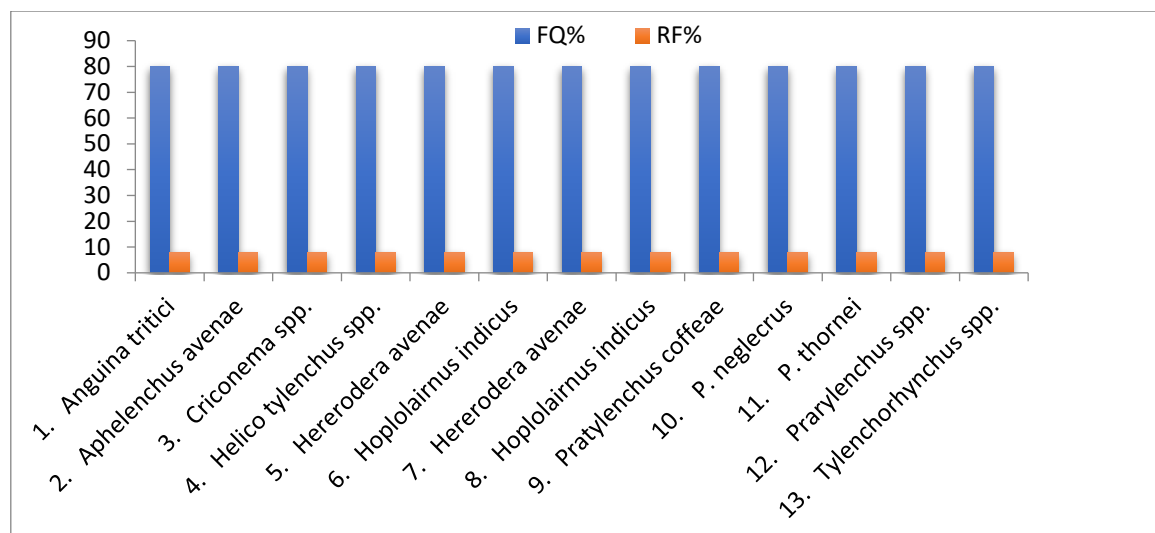


Figure3.2. Frequency of occurrence and Relative frequency of nematode species at site 3 Agriculture field with wheat crop.

Site 4: Agriculture Field with Maize Crop

At site 4, all the reported species were reported from maximum 10 and minimum from 7 samples out of 10 (Figure 4.1). In this field, 6 species of nematode were recorded. One species *Hererodera zae* was recorded in the entire sample collected with 100% Frequency of occurrence and 18.86% Relative frequency. Four species *Hoplolairnus indicus*, *Pratylenchus coffeae*, *P. thornei* and *P. zae*, were recorded in all the samples collected with 90% Frequency of occurrence and 16.98% relative frequency. One species of *Tylenchorhynchus* was recorded in all the samples collected with 70% Frequency of occurrence and 13.20% Relative frequency (Figure 4.2).

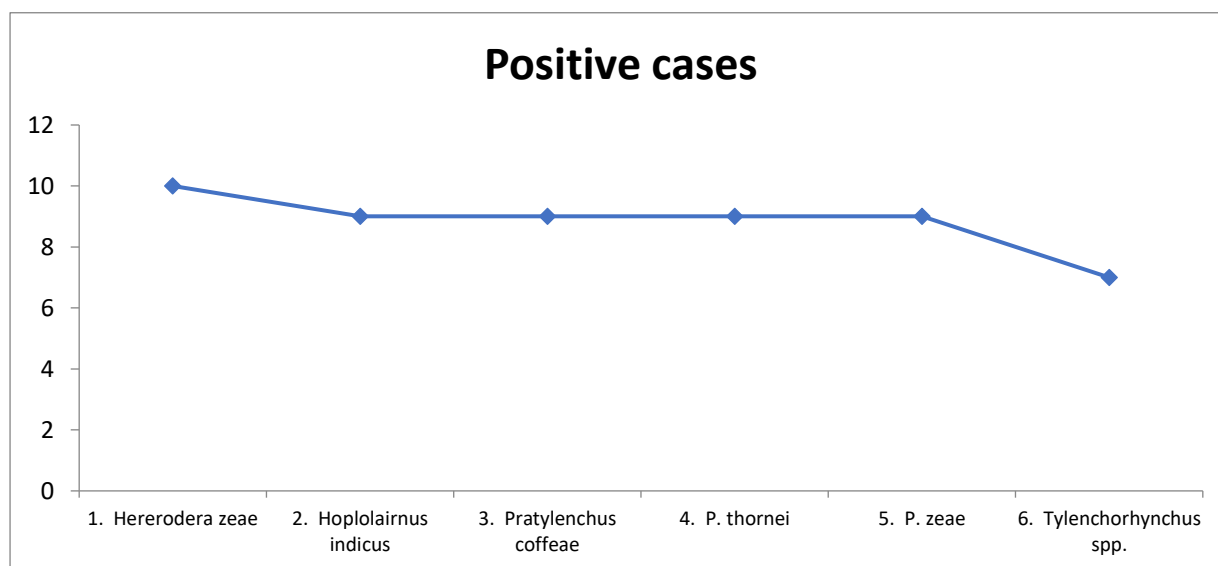


Figure4.1. Positive cases at site 4 Agriculture field with Maize crop

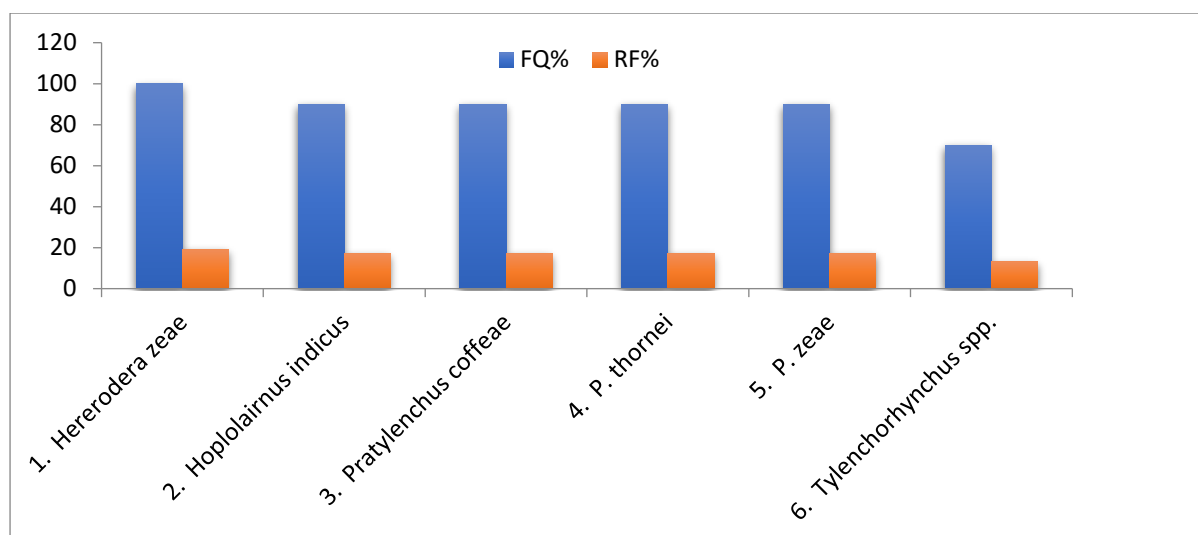


Figure4.2. Frequency of occurrence and Relative frequency of nematode species at site 4 Agriculture field with Maize crop

The chosen sites for soil sample collection viz; Agricultural site with vegetable crop, Agricultural site with oilseed crop, Agricultural site with Wheat crop, and Agricultural site with maize crop. Many species of nematodes were recorded from field samples collected during the present study. Root-knot nematodes, *Meloidogyne* spp and *Meloidogyne incognita* were found mostly in tropical areas and particular in warmer areas like Punjab. The species has economic significance and in

tropical and sub-tropical areas, its act as plant parasitic nematodes. These species reported from 232 host cases in all over the India and commonly found in agricultural and horticultural sites [13].

Helicotylenchus indicus, *Tylenchus* spp., *H. teres*, *Helicotylenchus* and *Hoplolairnus indicus* are the nematode species which belong to the spiral family of nematodes. These types of nematode species were reported to feed on the roots of a variety of plants, they can be found in large numbers in the soil around host roots. The nematode species are found all over the world, in a variety of climates, and are linked to the roots of a wide range of agricultural crops [14].

Longidorus elongates and *Merlinius brevidens* is medium size species of nematodes. It can be found in temperate locations all around the world. Economically it's a D rated pest and feed as an ecto-parasite on vegetable roots e.g., carrots, potato, pees, and ginger [15].

Paratylenchus spp. *P. penetrans* and *P. teres* species of nematode called Lesion nematodes. They are plant parasites that can cause root lesion disease in a variety of taxa of host plants in temperate zones around the world. There are around 350 host plants for *P. penetrans* for example soybeans, potatoes, corn, bananas and wheat among the agricultural crops [16].

Rotylenchus buxophilus and *R. reniformis* species of nematodes are found in tropical and sub-tropical region in the world. It can be present in temperate locations all around the world. Economically its A-rated pest and feed on vegetables like soybean, pineapple, tea etc. [17].

Trichodorus species of nematodes were recognized as a pest of crop and feeding on terrestrial roots. They are major plant parasites and virus vectors in terms of economics. *Xiphinema* spp are identified as Plant parasitic nematodes and known as dagger nematodes. During feeding, it has the ability to transmit viruses to plants. Dagger nematodes prey on the roots of host plants, causing economic damage and mortality, as well as spreading viral mosaic and withering diseases. It can be found in both temperate and tropical climates. The root system damage caused by dagger nematodes is similar to that caused by other plant ecto-parasitic nematodes [18].

4. Conclusion

In the present project the diversity of nematodes in soil were studied in laboratory of PG Department of Zoology, Sri Guru Teg Bahadur Khalsa College, Sri Anandpur Sahib, Ropar by using Cobb's sieving and decanting technique (Cobb, 1918). 70-90% positive cases were recorded from all soil samples. Soil

samples of all Agricultural field with 80-90% frequency of occurrence and 7-8% Relative frequency was recorded. Maximum numbers of nematodes recorded in these fields has economic importance for agricultural fields and horticultural fields.

Summary

In the present project of soil nematode diversity which is successfully estimated by using nematode extraction method given by Cobb (1918). The experimental work and soil sample collection was done by visiting four different sites 4-5 times during the study. These four sites were agricultural fields located in Sri Anandpur Sahib with different crops viz; Site 1: Agricultural field with vegetable crops, Site 2: Agricultural field with oilseed crops, Site 3: Agricultural field with wheat crops, Site 4: Agricultural field with Maize crop. The estimation part of the study was performed at PG Zoology Laboratory of PG Department of Zoology, Sri Guru Teg Bahadur Khalsa College, Sri Anandpur Sahib. The Frequency of occurrence of nematode species were 80-100% successful results and Relative frequency of nematode species in agriculture field were 16-20%. Various species of nematodes were identified with the help of microscopy. The site 1 Agriculture fields with vegetable crop having maximum number of nematode species were recorded. 17 species of nematodes were recorded with 70-100% Frequency of occurrence and 18.3% average of Relative frequency. 7-9% positive cases were recorded in this site. The site 2 Agriculture fields with oilseed crop having minimum number of nematode species were recorded. Only 5 species of nematode were recorded with 90-100% Frequency of occurrence and 30.2% average of relative frequency. 8-10% positive cases were recorded in this site. The site 3 Agriculture fields with wheat crop having 13 species of nematode were recorded with 80% Frequency of occurrence, 7.69% Relative frequency and 80% positive cases were recorded in this site. The site 4 Agriculture fields with maize crop having 6 species of nematode were recorded with 70-100% Frequency of occurrence, 40.2% Relative frequency and 9-10% positive cases were recorded in this site. The six nematode species *Rotylenchus buxophilus*, *R. reniformis*, *Merlinius incognita*, *Pratylenchus coffeae*, *P. teres* and *Hererodera zae* were recorded with 100% frequency of occurrence in all the four sites. In these sites, sixteen species of nematodes *Longidorus elomgates*, *Meloidogyne incognita*, *Merlinius brevidens*, *Paratylenchus spp.*, *P. penetrans*, *P. teres*, *Scurellonema petersi*, *Trichodoros spp.*, *Tylenchus spp.*, *Xiphinema spp.*, *M. arenaria*, *M. brevidens*, *Hoplolairnus indicus*, *P. coffeae*, *P. thornei* and *P. zae* were recorded with 90% frequency of occurrence in all agricultural sites selected during present study. Eighteen nematode species viz; *M. spp.*, *H. teres*, *Helicotylenchus*, *H. indicus*, *S. petersi*, *Ahngina tritici*, *Aphelenchus avenae*, *Criconema spp.*, *H. avenae*, *H. indicus*, *P. coffeae*, *P. neglecrus*, *P. thornei*, *P. spp.* and *T. chorhynchus spp.* were recorded with 80% frequency of occurrence in all sites. The nematode species *H. indicus* and *T. hynchus spp.* were recorded with 70% frequency of occurrence. The present study concluded that the useful nematodes were found in abundance in all the soil samples of selected sites. If the farmers continue to follow the eco-friendly agricultural practices, the soil nematode diversity will continue to enrich the soil fertility.

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